

Appl. No. 10/729,458
Reply to Office Action of July 13, 2006

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REMARKS

Claims 1-30 are pending in the present application. Claims 1, 13, 14 and 26 are amended. Claim 30 is canceled. Reconsideration of this application is respectfully requested.

Amendment of Claims 1, 13 and 26

Claim 1 has been amended to incorporate the forming step feature recited in Claim 13. No new issue of patentability is raised. Claim 13 has been amended consistent with the amendment of Claim 1.

Claim 26 has been amended to incorporate the features recited in Claim 30. Claim 30 is canceled without prejudice. No new issue of patentability is raised.

Claims Rejections under 35 U.S.C. §103(a)

A. Claims 1-13

The Action rejects Claims 1, 2, 4, 6, 10 and 11 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent Application No. 2005/0093063 to Lim et al. ("Lim"). Reconsideration and withdrawal of the rejection of the claims are respectfully requested in view of the amendment set forth above and arguments described below.

Claim 1 has been amended to recite "performing a first photoresist removal procedure resulting in partial removal of said photoresist shape while forming a second insulator layer on said bare first section of said semiconductor substrate." (Emphasis added).

As argued in the previous response, Lim fails to disclose or suggest exposing the bare first section of the semiconductor substrate. Further, Lim as a whole would not have motivated one of ordinary skill in the art to modify his method in view of its background of invention because exposing the bare surface of the semiconductor substrate teaches away Lim's method as argued in the previous response.

The Action alleges that one of ordinary skill in the art will accept a silicon rough surface after etch and pre-clean to expose a bare substrate and then form a second gate insulator over the bare substrate. This assertion, however, fails to disclose or suggest the performing step, which

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partially removes the photoresist shapes while forming a second insulator layer on the bare section of the semiconductor substrate.

In addition, Claim 1 recites "performing a procedure to convert said first insulator layer located on a second section of said semiconductor substrate, to a first gate insulator layer, and to convert said second insulator layer to a second gate insulator layer" Claim 1 further has been amended to recite "forming a first conductive gate structure on said first gate insulator layer and a second conductive gate structure on said second gate insulator layer."

In view of this amendment, the second insulator layer formed by the first photoresist removal procedure described above is provided as the second gate insulator layer, i.e., a gate dielectric layer. The second conductive gate structure is then formed over the second gate insulator layer. In other words, the second gate insulator layer provides a desired film quality such that it can tolerate a reliability test, e.g., a breakdown voltage test.

The Action states that silicon exposed to an oxidizing ambient, e.g. O₂ or H₂O even at room temperature, will form a very thin oxide layer, which is referred to as the second gate insulator layer by the Examiner by citing Silicon Processing for the VLSI Era, Volume 1, Lattice Press ("Wolf"). Applicants respectfully disagree. This oxide layer formed by O₂ or H₂O at room temperature is generally referred to as a "native oxide layer." As known in this art, a native oxide layer cannot provide a desired gate insulator film quality and serve as a gate insulator layer. Unlike a native oxide layer, the second insulator layer formed by the first photoresist removal procedure, e.g., using ozone water, can provide a desired gate insulator film quality. Accordingly, the combined teachings of Lim and Wolf would not achieve the claimed feature recited in Claim 1. Therefore, those in the art would not have been motivated in view of Wolf to modify Lim because a native oxide layer cannot serve as a gate insulator layer.

From the foregoing, it is submitted that Claim 1 is not obvious over the art of record and is, therefore, allowable for at least the reasons set forth above.

Claims 2, 4, 6, 10 and 11 depend from Claim 1 and are, therefore, allowable for at least the reasons described above in connection with Claim 1.

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The Action rejects Claim 3 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Wolf. Claim 3 depend from Claim 1 and is, therefore, allowable for at least the reasons set forth above.

The Action rejects Claim 4 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of U.S. Patent No. 6,784,060 to Ryoo ("Ryoo"). Claim 4 depends from Claim 1 and is, therefore, allowable over the art of record for at least the reasons set forth above.

Further, as argued above, the oxide layer formed by the photoresist removal step is converted into the second gate insulator layer, upon which the second conductive gate structure is formed. Nothing in Lim and Ryoo discloses or suggests converting an oxide layer formed from a photoresist removal step into a gate insulator layer. Indeed, Lim directs those of ordinary skill in the art to partially etch the oxide layer 14, leaving the oxide layer 20 over the substrate 12 as shown in FIG. 2. Without a bare or exposed silicon layer, no oxide layer can be formed on the remaining oxide layer 20 by a photoresist removal step. Based on Lim's description, one of ordinary skill in the art would not have been motivated to modify Lim's method in view of Ryoo.

Since nothing in the combined teachings of Lim, Wolf and Ryoo as a whole would lead one of ordinary skill in the art to form an oxide layer from a photoresist removal step as recited in amended Claim 1, it appears that hindsight knowledge gained from the present application is the only source of motivation to modify the method depicted in Lim. The motivation to combine various aspects of prior art references cannot come from Applicants' invention. See In re Oetiker, 24 USPQ2d 1443, 1447. Therefore, Applicants submit that Claim 4 is not obvious over the art of record and is, therefore, allowable for at least the additional reasons set forth above.

The Action rejects Claim 5 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Silicon Processing for the VLSI Era, Volume 1-Process Technology, Lattice Press ("S. Wolf and R.N. Tauber"). Claim 5 depends from Claim 1 and is, therefore, allowable for at least the reasons set forth above.

The Action rejects Claim 7 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of U.S. Patent Application No. 2005/0158671 to Shimizu et al. ("Shimizu"). Claim 7 depends from Claim 1 and is, therefore, allowable for at least the reasons set forth above.

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The Action rejects Claims 8 and 9 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Wolf. Claims 8 and 9 depend from Claim 1 and are, therefore, allowable for at least the reasons set forth above in connection with Claim 1.

The Action rejects Claims 12 and 13 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Wolf. Claims 12 and 13 depend from Claim 1 and are, therefore, allowable for at least the reasons set forth above in connection with Claim 1.

B. Claims 14-25

The Action also rejects Claims 14-17, 19, 22 and 23 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Ryoo.

Like Claims 1 and 4, Claim 14 recites the oxide conversion step, the conductive gate formation steps and the ozone containing mixture procedure, respectively. Thus, Claim 14 is not obvious over the art of record and is, therefore, allowable for at least the reasons set forth in connection with Claim 1.

Claims 15-17, 19, 22 and 23 depend from Claim 14 and are, therefore, allowable for at least the reasons described above.

The Action rejects Claim 18 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Ryoo and further in view of U.S. Patent Application No. 2002/0173156A1 to Yates et al. ("Yates"). Claim 18 depends from Claim 14 and is, therefore, allowable for at least the reasons set forth above.

The Action rejects Claim 20 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Ryoo and further in view of U.S. Patent Application No. 2005/0158671A1 to Shimizu et al. ("Shimizu"). Claim 20 depends from Claim 14 and is, therefore, allowable for at least the reasons set forth above.

The Action rejects Claim 21 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Ryoo and further in view of Wolf. Claim 21 depends from Claim 14 and is, therefore, allowable for at least the reasons set forth above.

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The Action rejects Claim 18 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Ryoo and further in view of U.S. Patent Application No. 2002/0173156A1 to Yates et al. ("Yates"). Claim 18 depends from Claim 14 and is, therefore, allowable for at least the reasons set forth above.

The Action rejects Claims 24 and 25 under 35 U.S.C. §103(a) as being unpatentable over Lim in view of Ryoo and further in view of Wolf. Claims 24 and 25 depends from Claim 14 and are, therefore, allowable for at least the reasons set forth above.

C. Claims 26-30

The Action rejects Claim 26 under 35 U.S.C. §103(a) as being unpatentable over U.S. Pat. No. 6,551,884 to Masuoka ("Masuoka") in view of Wolf.

Claim 26 recites "removing the photoresist pattern while forming a second insulator layer over the exposed top surface of the substrate region." Claim 26 further has been amended to recite "forming a first gate conductive structure over the remaining portion of the first insulator layer and a second gate conductive structure over the second insulator layer."

As conceded by the Action, Masuoka fails to disclose or suggest removing the photoresist pattern while forming an insulator layer over the exposed surface of the substrate region. Further, as argued in connection with Claim 1, the negative oxide layer formed by Wolf's disclosure cannot provide a desired film quality that can be provided for a gate insulator. Accordingly, one of ordinary skill in the art would not have been motivated to modify Masuoka's method in view of Wolf's teaching. It is submitted that Claim 26 is not obvious of art of record and is, therefore, allowable for at least the reasons.

The Action rejects Claim 27 under 35 U.S.C. §103(a) as being unpatentable over Masuoka in view of Wolf and further in view of U.S. Patent No. 6,286,231 to Bergaman et al. ("Bergaman"). Claim 27 depends from Claim 26 and is, therefore, allowable for at least the reasons set forth above.

The Action rejects Claims 28-30 under 35 U.S.C. §103(a) as being unpatentable over Masuoka in view of Wolf, in view of Bergman and further in view of U.S. Patent Application No.

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2002/0166572 to Chen ("Chen") and U.S. Patent Application No. 2003/0106572 to Nishiki et al. ("Nishiki"). Claim 30 is canceled and rejection to Claim 30 is thus moot. Claims 28-29 depend from Claim 26 and are, therefore, allowable for at least the reasons set forth above.

From the foregoing, reconsideration and withdrawal of the rejections to Claims 1-29 are respectfully requested.

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Conclusion

In view of the foregoing amendments and remarks, Applicants submit that this application is in condition for allowance. Early notification to that effect is respectfully requested.

The Commissioner for Patents is hereby authorized to charge any additional fees or credit any excess payment that may be associated with this communication to deposit account **04-1679**.

Respectfully submitted,



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